What is claimed is:

1. A method of reducing a cross-sectional dimension of a nano-opening in a nanostructured device, comprising the steps of:

   a. providing a solid substrate including a nano-opening defined by at least one wall surface fabricated in said substrate, said nano-opening having a given first cross-sectional area of nanometer-scale dimensions bounded by said at least one wall surface; and

   b. applying a coating material having a defined thickness to said at least one wall surface, thereby causing said nano-opening to have a second cross-sectional area of nanometer-scale dimensions reduced relative to said first cross-sectional area.

2. The method of claim 1 wherein said at least one wall surface comprises three wall surfaces defining a substantially rectangular, open nanochannel having a first width and a first depth, said second cross sectional area having a second width reduced by approximately twice said defined thickness.

3. The method of claim 2, including the step of enclosing said nanochannel with an uncoated cover member after applying said coating material, said channel having a second depth reduced by approximately said defined thickness.

4. The method of claim 2 including the step of enclosing said nanochannel prior to applying said coating material to provide a fourth wall surface, said nanochannel having a second depth reduced by approximately twice said defined thickness.

5. The method of claim 1 wherein said at least one wall surface is a continuous wall defining a hollow cylinder, and said second cross-sectional area has a diameter reduced by approximately twice the coating thickness.

6. A method according to claim 1, wherein said step of applying a coating material having a defined thickness is effected by ion implantation.

7. A method according to claim 1, wherein said step of applying a coating material having a defined thickness is effected by film deposition.

8. A method according to claim 1, wherein said step of applying a coating material having a defined thickness coats said at least one wall surface with a metal.

9. A method according to claim 1, wherein said step of applying a coating material having a defined thickness coats said at least one wall surface with an ionic material.

10. A method according to claim 1, wherein said step of applying a coating material having a defined thickness coats said at least one wall surface with a molecular film.

11. A method according to claim 10 where the molecular film is covalently attached the solid substrate.

12. A method according to claim 10 where the molecular film is non-covalently attached the solid substrate.

13. A method according to claim 1, wherein said step of applying a coating material having a defined thickness coats said at least one wall surface by chemical conversion of the solid substrate material.

14. A method according to claim 13, wherein said solid substrate materials is silicon and said chemical conversion is the formation of silicon oxide.

15. A method according to claim 1, wherein said step of applying a coating material having a defined thickness coats said at least one wall surface with a polymeric material.

16. A method according to claim 1, wherein said step of applying a coating material having a defined thickness

coats said at least one wall surface with at least one polyelectrolyte material.

17. A method according to claim 16, further including the step of applying to said at least one wall surface a polyelectrolyte material providing at least one additional coating of defined thickness, the charge of the polyelectrolyte which provides said at least one additional coating being opposite to the charge of the polyelectrolyte to which it is applied.

18. A method according to claim 1, where the step of applying a coating material having a defined thickness coats said at least one wall surface and modifies the solid-liquid interaction characteristic.

19. A method according to claim 2, wherein said step of providing a solid substrate with an open nanochannel includes the step of providing a substrate having both said open nanochannel and a microchannel having a free space with a third cross-sectional area greater than said first cross-sectional channel area, said microchannel being connected to said nanochannel, said coating step also including coating said microchannel with a coating of said defined thickness to reduce the free space of said microchannel, said thickness being sufficiently small to maintain the cross-sectional area of said

microchannel free space larger than the cross-section area of said nanochannel free space.

20. A method according to claim 3, wherein the step of applying a coating material to the open nanochannel is carried out while maintaining the adjacent substrate surface substantially free of said coating material.

21. A method according to claim 20, wherein said adjacent substrate surface is maintained substantially free of said coating material, by applying a resist layer to said adjacent substrate surface prior to application of said coating material, and removing said resist layer after application of said coating material.

22. A method of producing a nanometer-scale conduit in a nanostructured device, comprising the steps of:

providing a solid substrate having an uncovered surface;

forming in said surface an open nanochannel having a bottom wall spaced below said uncovered surface and opposed side walls, said nanochannel having a given first cross-sectional channel area of nanometer-scale dimensions defined by the free space between said opposed sidewalls and the depth of said bottom wall below said uncovered surface;

applying a coating material having a defined thickness to said opposed side walls and said bottom wall to reduce the free space between said coated opposed side walls by a factor of two times the defined thickness, and thereby to reduce the free space in said first cross sectional area to provide a flow channel having a flow area with a second cross-sectional area of lesser nanometer-scale dimensions relative to said first cross-sectional channel area; and

applying a planar cover member to said uncovered surface overlying said coated, open flow channel to thereby close the top of said flow channel and form said nanometer-scale conduit.

23. A method according to claim 22, wherein said open nanochannel is formed by chemical etching.

24. A method according to claim 22, wherein said open nanochannel is formed by milling said surface with a finely-focused ion beam to form said open nanochannel.

25. A nanostructured device for use in transporting a fluid medium having components of differing maximum lateral dimension, said device having a nanometer-scale conduit and comprising a solid substrate having an upper surface, a nanochannel having a bottom wall spaced below said upper surface and opposed side walls, said nanochannel

having a given first cross-sectional channel area of nanometer scale dimensions defined by the free space between said opposed sidewalls and the depth of said bottom wall below said upper surface, a coating material having a defined thickness covering said opposed side walls and said bottom wall, said coating material reducing the free space between said opposed side walls by a factor of approximately two times the defined thickness, and thereby providing a cross-sectional flow area in said nanochannel of reduced nanoscale dimensions relative to said first cross-sectional channel area, and a planar cover member on said upper surface overlying said coated nanochannel, which closes the top of said channel and forms said nanometer-scale conduit.

26. A nanostructured device according to claim 25, wherein said substrate includes a microchannel having lateral dimensions greater than the differing maximum lateral dimensions of the fluid medium components to accommodate flow of said fluid medium therethrough, said microchannel communicating with said coated, nanometer-scale conduit, whereby flow from said microchannel into said nanometer-scale conduit is restricted to components of said fluid medium having a maximum lateral dimension smaller than said lateral dimensions of said coated nanometer-scale conduit.

27. A nanostructured device according claim 26 wherein the rate of transport of said fluid medium components through said nanoscale conduit is dependent on the lateral dimensions of the fluid medium components relative to the lateral dimensions of the nanoscale conduit.

28. A nanostructured device according to claim 25, wherein said fluid medium components include molecules of differing dimensions, said microchannel has a cross-sectional area larger than the molecules in said fluid medium, and the free space dimensions of said nanometer-scale conduit is larger than the dimension of at least one of said molecules and is smaller than the dimension of at least one other of said molecules.

29. A nanostructured device according to claim 25, wherein said coating comprises a metal film.

30. A nanostructured device according to claim 25, wherein said coating comprises an ionic material.

31. A nanostructured device according to claim 25, wherein said coating comprises a molecular film.

32. A nanostructured device according to claim 25, wherein said coating comprises polymeric material.

33. A nanostructured device according to claim 25, wherein said coating comprises at least one polyelectrolyte material.

34. A nanostructured device according to claim 33, wherein said coating comprises a plurality of layers of polyelectrolyte material, each layer being opposite in charge to its adjacent layer.

35. A nanostructured device according to claim 25, wherein the lateral dimension of said nanometer-scale conduit is approximately one nanometer.

36. A nanostructured device comprising a solid substrate having a nano-opening of predetermined cross-sectional area defined by at least one wall surface which is fabricated in said substrate and which is coated with a coating material so as to reduce said predetermined cross-sectional area.

37. The nanostructured device of claim 36, wherein said at least one wall surface is a continuous wall defining a hollow cylinder.

38. The nanostructured device of claim 36, wherein said coating material is modified to include a sensing agent which specifically binds a target substance of interest.

39. The nanostructured device of claim 36, wherein said coating material is hydrophobic and is associated with a molecular assembly.

40. The nanostructured device of claim 39 wherein said molecular assembly is a transmembrane protein.

41. The nanostructured device of claim 40, wherein said transmembrane protein is an ion channel.

42. The nanostructured device of claim 41, wherein said ion channel is alpha-hemolysin.

43. The nanostructured device of claim 39, wherein said coating material is selected from the group consisting of hydrophobic polyelectrolyte multilayers and hydrophobic linear polymers and said transmembrane protein is alpha-hemolysin.

44. A method of analyzing a biomolecule, said method comprising:
   a) providing a nanostructured device as claimed in claim 36;
   b) applying a potential difference between spaced apart locations in the nano-opening of said nanostructured device, thereby causing an electric current between said locations and producing an electrical force which

is effective to cause a biomolecule which is exposed to said electrical force to pass into said nano-opening;

c) exposing a biomolecule to the electrical force produced in step b;

d) measuring said electrical current before said biomolecule passes into said nano-opening; and

e) measuring said electric current after said biomolecule passes into said nano-opening, the relative magnitude and temporal changes of said current measurements being indicative of at least one of the physical or chemical properties of said biomolecule.

45. The method of claim 44, wherein said biomolecule is a linear biopolymer.

46. The method of claim 44, wherein said nano-structure device is provided with a hydrophobic coating material, and includes a further step of engaging a transmembrane protein with said hydrophobic coating material before exposing said biomolecule to said electrical force.

47. The method of claim 44, wherein said coating material is modified to include a sensing agent which specifically binds said biomolecule.

48. A nanostructured device comprising a solid substrate having a nano-opening defined by at least one wall

surface fabricated in said substrate, said nano-opening being coated with a coating material having at least one property which is effective to promote self-assembly of a molecular structure brought into engagement with said coating material.

49. The nanostructured device of claim 48, wherein said at least one wall surface is a continuous wall defining a hollow cylinder.

50. The nanostructured device of claim 48, wherein said coating material is hydrophobic and said molecular structure is a transmembrane protein.

51. The nanostructured device of claim 50, wherein said transmembrane protein is an ion channel.

52. The nanostructured device of claim 50, wherein said coating material is selected from the group consisting of hydrophobic polyelectrolyte multilayers and hydrophobic linear polymers, and said transmembrane protein is alpha-hemolysin.

53. A method of making a device for analysis of a biomolecule, said method comprising:

a) providing a solid substrate having a nano-opening defined by at least one wall surface fabricated in said substrate;

b) applying to said wall surface a coating material having at least one property which is effective to promote self-assembly of molecular structures brought into engagement with said coating material; and

c) engaging a molecular structure capable of self-assembly with said coating material.

54. The method of claim 53, wherein said molecular structure capable of self-assembly is brought into engagement with said coating material under the influence of an electrical force.

55. The method of claim 53, including the further step of disengaging said molecular structure from said coating material by reversing the direction of said electrical force.

56. The method of claim 53, including the further step of preventing engagement of said molecular structure with said coating material by reversing the direction of said electrical force.